DRAFT STREAM MITIGATION GUIDELINES FOR THE STATE OF TENNESSEE

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER POLLUTION CONTROL
NATURAL RESOURCES SECTION

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INTRODUCTION

Commercial, residential and agricultural land development, and construction of linear transportation systems have impacted Tennessee's streams and wetlands often resulting in loss of stream length or beneficial physical characteristics. Compensatory mitigation for wetland impacts has been required in Tennessee since 1988. However, wetlands mitigation does not provide appropriate replacement of aquatic functions lost due to impacts to fluvial systems. While mitigation for certain stream impacts has been required for years, in July, 2000, the Tennessee Water Quality Control Board adopted rules [Chapter 1200-4-7-.04(7)] that more clearly specify the requirement that permits for the alteration of streams must not result in a net loss of water resource value. The US Army Corps of Engineers (CE) and Tennessee Division of Water Pollution Control (WPC) now require compensatory mitigation for permitted impacts to Tennessee's streams. Compensatory mitigation may be accomplished through the replacement, restoration and/or enhancement of degraded stream channels utilizing fluvial geomorphological principles, natural channel designs, and bioengineering techniques. Preservation of threatened, unique, or ecologically significant streams or rivers and their riparian area may only be included as a component of compensatory mitigation as approved by the Stream Mitigation Review Team (SMRT).

This guidance was prepared by the Tennessee Division of Water Pollution Control (WPC) in cooperation with the Stream Mitigation Review Team (SMRT). The SMRT is composed of representatives from U.S. Army Corps of Engineers (CE), U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (FWS), Tennessee Valley Authority (TVA), and the Tennessee Wildlife Resources Agency (TWRA). This document reflects the current professional judgment of these resource managers as to the reasonably likely impacts associated with certain alterations as well as the aquatic benefits of various mitigation treatments. It is intended to be fair and flexible and is subject to periodic revision and update as new assessment procedures and stream monitoring data support changes.

Topics addressed in this guidance document include federal and state regulatory guidance and policies, activities requiring compensatory mitigation, classification of stream alterations, mitigation activities and corresponding ratios, monitoring requirements, and definitions of terms related to stream mitigation. These guidelines should not be construed as reducing the significance and enforceability of the *CWA* 404(b)(1) Guidelines or the Rules of the Tennessee Water Quality Control Board Chapter 1200-4-7. The guidelines require consideration of practicable alternatives that would avoid or minimize impacts to Waters of the United States (including streams) prior to considering compensatory mitigation.

REGULATORY AUTHORITIES AND GUIDELINES

***Section 10 of the River and Harbor Act of 1899*:** In accordance with *Section 10 of the River and Harbor Act*, the CE is delegated the responsibility to administer a permit program regulating dredge or fill activities in Navigable Waters of the United States.

Section 404 of the Clean Water Act: In accordance with the *Section 404 of the CWA* as amended in 1977, the CE is delegated the responsibility to administer a permit program regulating the discharge of dredged or fill materials in Waters of the United States including wetlands. **The purpose of the *Clean Water Act* is to restore and maintain the physical, chemical, and biological integrity of the nation's waters.** Under both of the above programs, the CE is granted the authority to require permits and to receive and evaluate permit applications affecting Waters of the United States. Frequently, the required public interest review of applications results in finding that the public must be compensated for the unavoidable aquatic resource losses, including stream resources.

***Section 404(b)(1) Guidelines of the Clean Water Act*:** Section 230.10(d) of the *Section 404(b)(1) Guidelines* states in part that "…no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem."

401 Water Quality Certification Program: *Section 401 of the Clean Water Act* delegates authority to the states to issue a 401 Water Quality Certification for projects that require a federal permit (such as a Section 404 Permit). The "401" is essentially the verification by the state that a given project will not violate state water quality standards.

***Tennessee Water Quality Control Act (TWQCA)* of 1977:** TCA 69-3-102(a) states that "…It is further declared that the purpose of this part is to abate existing pollution of the waters of Tennessee, to reclaim polluted waters, to prevent future pollution of the waters, and to plan for the future use of the waters so that the water resources of Tennessee might be used and enjoyed to the fullest extent consistent with the maintenance of unpolluted waters."

***Tennessee Water Quality Control Act* of 1977:** TCA 69-3-108(e) states that "The commissioner may grant permits authorizing activities or discharges, but in granting such permits shall impose such conditions, including effluent standards and conditions and terms of periodic review, as are necessary to accomplish the purposes of this part, and are not inconsistent with the regulations promulgated by the board thereunder. Under no circumstances shall the commissioner issue a permit for an activity which would cause a condition of pollution either by itself or in combination with others."

Rules of the Tennessee Water Quality Control Board: The Rules 1200-4-7-.04(7)(a) state "If an applicant proposes an activity that would result in an appreciable permanent loss of resource value of a state water, the applicant must provide mitigation which results in no net loss of resource values."

Rules of the Tennessee Water Quality Control Board: The Rules outline Classified Uses of Surface Waters in 1200-4-3-.02(2) by stating "Waters have many uses, which in the public interest are reasonable and necessary. Such uses include sources of water supply for domestic and industrial purposes, propagation and maintenance of fish and other aquatic life, recreation in and on the waters including the safe consumption of fish and shellfish, livestock watering and irrigation, navigation, generation of power, propagation and maintenance of wildlife, and the enjoyment of scenic and aesthetic qualities of waters.

Rules of the Tennessee Water Quality Control Board: The Rules including the Tennessee Antidegradation Statement in 1200-4-3-.06 states that "It is the purpose of Tennessee's standards to fully protect existing uses of all surface waters as established under the *Act*. In bodies of water identified as Tier I by the Division, existing uses will be maintained by application of General Water Quality Criteria. In Tier I waters found to not meet water quality standards for a substance, new or increased discharges of that substance will not be allowed.

***Section 26a of the Tennessee Valley Authority Act*:** Prohibits the erection or maintenance of any "dam, appurtenant works, or other obstruction, affecting navigation, flood control or public lands or reservations…across, along, or in" the Tennessee River or any of its tributaries until plans for its construction, operation, and maintenance have been submitted and approved by the Board of directors of the Tennessee Valley Authority.

***TCA* 70-4-206 *Pollution of Waters*:** Prohibits the direct or indirect discharge of any pollutant into any waters public or private that could be injurious to fish and aquatic life or that results in the destruction of habitat for fish and aquatic life.

***The Fish and Wildlife Coordination Act (FWCA) of 1958*:** The FWCA expresses the will of Congress to protect the quality of the aquatic environment as it affects the conservation, improvement and enjoyment of fish and wildlife resources. The Act requires the CE to coordinate its' regulatory programs with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, and the state fish and wildlife agency.

***Endangered Species Act* (ESA):** The ESA declares the intention of Congress to conserve threatened and endangered species and ecosystems on which those species depend. The Act requires the CE to consult with the U.S. Fish and Wildlife Service to insure the regulated activities are not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of designated critical habitats.

STREAM ALTERATIONS REQUIRING COMPENSATORY MITIGATION

Stream alterations, including but not limited to culverts, stream relocations, impoundments, and modifications to stream channels, banks, and riparian areas may result in a permanent loss or degradation of the resource. Alterations of the physical characteristics of the stream or its riparian zone may cause a related change in physical habitat, water quality, aquatic fauna, and ultimately a decrease in the resource value.

Physical alterations may significantly degrade a streams ability to support its classified uses. Such impacts would be considered pollution. The Commissioner cannot issue a permit that would likely result in a condition of pollution. As defined in the *TWQCA*, pollution means alteration of the physical, chemical, biological, bacteriological, or radiological properties of waters of the state including, but not limited to, changes in temperature, taste, color, turbidity, or odor of the waters that will:

a) Result or will likely result in harm, potential harm or detriment of the public health, safety, or welfare;

b) Result or will likely result in harm, potential harm or detriment to the health of animals, birds, fish, or aquatic life;

c) Render or will likely render the waters substantially less useful for domestic, municipal, industrial, agricultural, recreational, or other reasonable uses; or

d) Leave or likely leave the waters in such condition as to violate any standards of water quality by the board.

The Rules of the Tennessee Water Quality Control Board [Chapter 1200-4-7-.01(1)] require that consideration must be given to ways to avoid or minimize impacts. When alterations can be permitted, unavoidable impacts to streams that result in loss or degradation of the resource require compensatory mitigation. The purpose of compensatory mitigation is to replace the water resource values that are lost or impaired due to the authorized activity. The Rules do not presume the right of a permit applicant to create a permanent loss of resource value in exchange for mitigation. Permits allowing permanent loss of resource value are issued only when there is no practicable alternative to the proposed activity.

Examples of Alterations Requiring Mitigation:

Culverting/Filling

- Culverts for road crossings greater than 200 feet in length
- Culverts of any length associated with projects other than road projects
- Elimination of stream by filling

Impoundments

- Impoundments that result in a significant degradation of habitat (500 ft.)
- Impoundments that significantly change the downstream hydroperiod, water temperature, water chemistry, and/or species composition

Stream Relocations

- Relocations resulting in a loss of stream length
- Relocations with an oversized channel (designed to convey flood flows)
- Relocations without a natural channel design (including in-stream habitat and/or a riparian zone established according to the requirements outlined in this document)
- Relocations requiring armored bottom and/or banks (synthetic liners, riprap or concrete lined channels)

Channel Modifications

- Channel fill, deepening, straightening or widening
- The removal of vegetation or unconsolidated sediments for the purpose of flood control or that results in a degradation of the resource
- Channel modifications eliminating in-stream habitat
- Placement of riprap or concrete in the bottom and/or sides of the stream channel
- Placement of riprap along banks for distances greater than the 300 linear feet allowed under the *General Permit for Bank Stabilization*

AQUATIC RESOURCES WITH SPECIAL DESIGNATIONS

All surface waters have certain classified uses that are protected by law. The Tennessee Antidegradation Statement 1200-4-3-.06(1) states "It is the purpose of Tennessee's Standards to fully protect existing uses of all surface waters as established under *the Act*." Classified surface uses for Tennessee streams are:

- Navigation
- domestic water supply
- industrial water supply
- fish & aquatic life
- recreation
- irrigation
- livestock watering & wildlife

Physical alterations resulting in degradation may not be permitted on some streams. Permanent or long-term degradation is not permitted on surface waters designated as high quality or Tier II. In surface waters designated by the Water Quality Control Board as Tier III or Outstanding National Resource Waters (ONRW), no physical alteration will be permitted unless the activity will result in no degradation of the resource. Likewise, stream segments included on the

303(d) List of Impaired Waters are protected from additional alterations or discharges listed as the source of impairment. Due to the sensitive nature of these resources, alterations resulting in degradation to high quality, Tier II, Tier III, ONRWs, and 303(d) listed streams will receive special consideration in accordance with state and federal rules.

CLASSIFICATION OF STREAM ALTERATIONS

Stream alterations present a continuum of impacts that range from slight degradation to elimination of classified uses. In order to determine the type of compensation that applies to these various kinds of alterations or resource losses, it is necessary to group certain alterations for the purpose of quantifying resources loss. The following categories were developed by comparing the habitat conditions that would likely exist in the altered watercourse versus the conditions existing in a non-impacted stream. Ratios for compensatory mitigation have been developed. These ratios may be found on page 19 (Appendix B) of this document.

Elimination

- Culverts/Filling
- Loss of stream length
- Concrete lined channels (bottom and sides)

Degradation II

- Riprap lined channels (bottom and sides)
- Channel modifications that significantly increases the existing channel cross sections to convey flood flows
- Riprap or concrete lined stream banks (both banks)
- Impoundments

Degradation I

- Loss of riparian canopy on proposed stream relocations
- Channel modifications that deviate from or degrade the proper pattern, profile, dimension, and/or in-stream habitat (riffles, pools, structure, etc.)
- Synthetic channel liners along banks

STREAM MITIGATION REQUIREMENTS

Compensatory stream mitigation may be accomplished through the restoration of previously channelized streams, stabilization of eroding banks, re-establishment of riparian buffers, construction of in-stream habitat, livestock exclusion, removal of non-point source pollutants, reversal of adverse hydrological modifications, and any combination thereof. Stream mitigation should be designed to achieve the maximum level of improvement or, in other words, to return the channel as close as possible to its most probable natural state, given the individual constraints of the project location and watershed conditions. While site-specific constraints may reduce the potential of mitigation sites (and correspondingly decrease the mitigative potential), mitigation aims to establish the maximum biological, chemical, and physical integrity possible in the current environment. Mitigation projects with greater ecological benefits receive greater mitigation credit. It is the responsibility of the applicant or their agents to identify suitable mitigation sites and develop a compensatory mitigation plan that will adequately offset the impacts from the proposed project. **The proposed mitigation plan should be consistent with the guidance and ratios set forth in this document.** Alternatively, applicants may propose mitigation with varying ratios, or other deviations from this guidance provided that they provide adequate scientific justification. All mitigation plans must be reviewed and approved by state and federal regulatory agencies prior to permit issuance and mitigation implementation.

Examples of Streams Offering Mitigation Opportunities

- Channelized streams
- Culverted and concrete or riprap lined streams
- Streams impacted by historical mining activity
- Streams with significant sections of eroding banks and little or no riparian vegetation
- Degraded urban streams with skewed hydrographs and/or minimal in-stream habitat or aquatic life
- Degraded rural streams where in-stream and/or riparian habitat has been largely eliminated by unrestricted livestock access and/or agricultural practices

STREAM MITIGATION TREATMENTS

Riparian Buffer Restoration

Riparian buffers are essential for healthy streams. An established riparian buffer provides canopy, habitat and wildlife corridors, stabilizes banks, filters sediment from overland runoff, and dissipates energy during flood events. A riparian buffer should be a consideration of any compensatory mitigation proposal. If the mitigation stream does not have an established riparian buffer, then the mitigation plan must include the re-establishment of such a buffer. Riparian buffer should typically extend from bankfull elevation for 50 feet on both sides of the stream or a distance equal to 3 times the width of the stream, whichever is greater. Mitigation ratios may vary slightly according to the available width of the riparian zone. Partial mitigation credit may be awarded for increasing the riparian buffer on streams with a minimal buffer width. **Re-establishment of a vegetated riparian buffer must adhere to the following conditions in order to qualify as compensatory stream mitigation:**

- Stream banks must be planted with native vegetation that represents both woody (trees and shrubs) and herbaceous species.
- Trees must be planted at a rate of 400 stems per acre beginning at bank full elevation within the channel extending for 50 feet on each side from top of bank or for 3 times the width of the stream from top of bank.
- No species may comprise more than 1/3 of the total planted trees.
- Seedlings/trees must be guaranteed at a 75% survivorship for the duration of the required monitoring period.
- The riparian zone must be protected in perpetuity under a conservation easement that prohibits disturbance.
- Where livestock is present riparian buffers must be physically protected from livestock. A fence must be erected and maintained at all times where livestock is present.

Bank Stabilization

Streams with significantly degraded streambanks may serve as compensatory mitigation projects. Significantly degraded streambanks are actively eroding and have little or no riparian vegetation. Bank stabilization should incorporate bioengineering techniques to slow erosive near-bank velocities and protect easily erodible soils. Examples of bioengineering techniques may include the use of rock vanes, rock weirs, log deflectors, and

cedar tree revetments. Bioengineering projects may also include bank re-sloping and riparian zone restoration. Examples of some common bioengineering techniques may be found in the *Riparian Restoration and Streamside Erosion Control Handbook*.

Livestock Exclusion

Livestock exclusion may be credited as compensatory mitigation only when the presence of the livestock has resulted in a significant impact to the stream, streambanks, and or riparian zone. Streams that have been significantly impacted commonly exhibit sloughing banks, sparse riparian canopy, and excessive sedimentation resulting in embedded substrate. Severely impacted streams may also contribute to water quality problems such as nutrient loading. Livestock exclusion involves removing or excluding livestock from the stream and riparian area using fencing. The stream and riparian area must be protected from these impacts in perpetuity.

Perpetual Protection

Stream alterations requiring mitigation are typically permanent impacts. Therefore, all stream mitigation projects shall be protected in perpetuity through a conservation easement, deed transfer, or other legally binding agreement. The Tennessee Wildlife Resources Foundation, or other approved environmental or government organization shall act as the trustee of these agreements. The agreements would prohibit physical alterations including, but not limited to agriculture, logging, and development. At the end of the required monitoring period, the trustee organization would assume responsibility for the enforcement of the protective terms and conditions under these agreements. **Mitigation credit will only be given to projects that are protected in a perpetual conservation easement or other binding, permanent protective measure.**

Stream Mitigation Program

An applicant may propose to fulfill the compensatory mitigation requirement by procuring stream mitigation from an approved Stream Mitigation Program (SMP). When the application processing is complete, a water quality permit may be issued. The conditional permit may be issued after the applicant has purchased the appropriate mitigation from the Stream Mitigation Program. The program trustee or sponsor would then be responsible for providing the required compensatory mitigation.

STREAM MITIGATION CLASSIFICATION

Replacement

Stream replacement may be accomplished by removing existing culverts and/or concrete lined channels. The mitigated stream must be restored to a natural, stable channel based on reference conditions. The restoration of the stream will typically include rebuilding the appropriate channel pattern, profile, and dimensions, and riparian zone to the extent that watershed conditions will allow. For the purposes of compensatory mitigation, replacement may be credited up to a 1:1 ratio (Appendix B).

Restoration

Stream restoration is the process of returning a significantly degraded, disturbed, or totally altered stream, including adjacent riparian zone and flood-prone area, to a natural stable condition based on reference conditions. Restoration will typically include rebuilding the appropriate channel pattern, profile, dimensions, and riparian zone to the extent that watershed conditions will allow. For purposes of compensatory mitigation, restoration may be credited up to a 1.5:1 ratio (Appendix B).

Enhancement II

Enhancement II activities require significant bank stabilization (>33% of total project length), introduction of in-stream habitat, and the re-establishment of native herbaceous and woody vegetation in the riparian zone along both banks of the stream. Enhancement II activities may be credited up to a 3:1 ratio (Appendix B).

Enhancement I

Enhancement I involves any combination of bank stabilization, livestock exclusion, introduction of in-stream habitat, and riparian zone restoration along both banks of the stream. Enhancement I activities may be credited within a range from 4:1 to 6:1 ratio (Appendix B).

Preservation

Preservation of a threatened, unique or ecologically significant aquatic resource may serve as compensatory mitigation, provided that it is a component of a restoration project. High quality, relatively undisturbed resources qualify for preservation credit only if the site lies adjacent and in the path of ongoing development, usually in urban settings, and/or within environments where

endangered species dependent on the preserved watercourse are at risk. All preservation projects require a perpetual conservation easement that restricts alterations to the watercourse and land use within the riparian area. The buffer width required for mitigation credit is typically greater than the riparian buffer required for restoration/enhancement projects. Preservation as a component of a restoration project may be credited within a range of 10:1 to 60:1 ratio (Appendix B).

STREAM MITIGATION SITE SELECTION

Site selection for compensatory mitigation should focus on significantly degraded streams near the impact site. Mitigation projects usually require some level of disturbance and a corresponding recovery period. As defined in EPA guidance, only stream segments with a habitat score less than 75% of the reference conditions are considered impaired. Only stream segments considered impaired will qualify for compensatory mitigation credit. A qualified biologist must complete EPA's habitat assessment (Appendices E & F). The assessment score must be compared with the mean reference stream score. This will establish the general level of impairment.

Mitigation will generally be performed on a stream with the same habitat as the impacted stream, i.e. cold, cool, warm water habitat. The following criteria should be used as guidance for mitigation site selection:

- Preference to the same Level III Ecoregion ("Ecoregions of Tennessee" map, TDEC, USGS, EPA, & NRCS, 1998), or the same 8-digit HUC as the impact stream (Appendix D).

- Locate mitigation projects on streams within one stream order as the impacted stream.

- The mitigation watershed should be consistent with the impact watershed (i.e. rural vs. urban).

- All other factors being equal, priority should be given to 303(d) listed streams for which stream mitigation efforts may provide a means to alleviate the causes or sources of water quality and/or habitat impairment.

MONITORING REQUIREMENTS

Monitoring is required for all stream mitigation projects. The objective of monitoring is to quantify the success of a mitigation project. The success of such projects must be guaranteed and documented in annual monitoring reports for a period of 3 to 5 years after completion of the project. Successful mitigation projects should result in stream segments with stable banks, in-stream habitat, and/or a healthy riparian buffer.

Monitoring reports must include a narrative description and photos accurately depicting the stream and riparian habitat. Monitoring requirements must also include habitat assessments to document pre- and post- project habitat conditions. Annual riparian vegetation surveys documenting the survivorship of planted riparian species are required for all mitigation projects that include a riparian restoration component. Monitoring reports for replacement and restoration projects must include annual surveys of channel morphology (pattern, profile, and dimension).

The type of mitigation treatment will determine the type of monitoring required. A qualified biologist or environmental specialist should complete mitigation monitoring reports. The first monitoring report should be submitted at the beginning of the first growing season after completion of the mitigation project and should be submitted annually for a period from 3 to 5 years.

Narrative Description/Photos

The narrative should include a description of the physical condition of the mitigation stream including a description and photos of observed aquatic life, bank stability, in-stream habitat, substrate, and riparian zone.

Habitat Assessment

A pre-project habitat assessment (Appendix E) must be completed to document existing conditions within the degraded stream segment. A second post-project habitat assessment must be completed at the end of the required monitoring period. A comparison of the two assessments will help quantify the ecological gain of the mitigation project.

Riparian Vegetation Survey

An annual detailed vegetative survey including photos of the riparian plantings is required for all mitigation projects that include riparian restoration (see Riparian Buffer Restoration page 10). The survey should be completed during the normal growing season. Planted riparian species must be guaranteed at a 75% survivorship for the duration of the required monitoring period.

Channel Morphology Survey

An annual survey of channel pattern, profile, and dimension is required for all replacement and restoration projects. The survey should include detailed cross-sections and photos of the stream channel at pre-determined locations. The success of a replacement or restoration project is determined by channel stability, adjustments to channel pattern, profile, and dimension.

MONITORING REQUIREMENTS

Level I Monitoring Requirements (3 years)

- Narrative description and photos of pre-project conditions
- Pre-project habitat assessment
- Annual narrative description and photos
- Annual riparian vegetation survey
- Post-project habitat assessment at the end of the required monitoring period

Level II Monitoring Requirements (5 years)

- Narrative description and photos of pre-project conditions
- Pre-project habitat assessment
- Annual narrative description and photos
- Annual riparian vegetation survey
- Post-project habitat assessment at the end of the required monitoring period

Level III Monitoring Requirements (5 years)

- Narrative description and photos of pre-project conditions
- Pre-project habitat assessment
- Annual narrative description and photos
- Annual riparian vegetation survey
- Annual channel morphology survey
- Post-project habitat assessment at the end of the required monitoring period

REFERENCES AND RELATED READING

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APPENDIX A (Glossary)

Bankfull - corresponds to the discharge (typically 1.5 yr), at which channel maintenance is most effective, that is, the discharge at which moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work that results in the average morphic characteristics of channels.

Compensatory Mitigation- mitigation undertaken to replace lost or adversely impacted habitat with habitat having similar functions of equal or greater ecological value.

Channelization- the alteration of stream channels including but not limited to straightening, deepening, widening, or enlarging.

Degradation- the alteration of the properties of waters by the addition of pollutants or the elimination of habitat. Alterations not resulting in a condition of pollution that are of a temporary nature or those alterations having de minimus impact (no measurable or less than 5%) loss of assimilative capacity will not be considered degradation. Degradation will not be considered de minimus with a substantial loss (more than 5%) of assimilative capacity.

Ecoregion- An area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables.

Enhancement- the improvement to one or more of the structural or functional attributes of a stream.

Fluvial Geomorphology- the study of landforms associated with river or stream channels and the processes that form them.

In-stream Habitat- natural structures or structures constructed using natural materials within stream channels that provide habitat for aquatic life.

Riparian Zone- a vegetated area along streams and rivers that provides canopy, bank stabilization, pollution buffering, and wildlife habitat.

Reference Conditions- the ecological and hydrological characteristics of a non-impacted stream reach within an ecoregion of interest

Replacement- removing a previously encapsulated stream and returning it to the surface in a natural, stable channel with a riparian zone.

APPENDIX A (Glossary)

Restoration- the process of returning a significantly degraded, disturbed, or totally altered stream, including adjacent riparian zone and flood-prone area, to a natural stable condition based on reference conditions. Restoration will typically include rebuilding the appropriate channel pattern, profile, dimensions, and riparian zone to the extent that watershed conditions will allow.

Watershed- The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common point.

APPENDIX B

		Treatments				
		Replacement	Restoration	Enhancement II	Enhancement I	Preservation
Alterations	Elimination X1	1:1	1.5:1	3:1	4-6:1	10-60:1
	Degradation II X 0.75	1:1	1.5:1	3:1	4-6:1	10-60:1
	Degradation I X 0.50	1:1	1.5:1	3:1	4-6:1	10-60:1

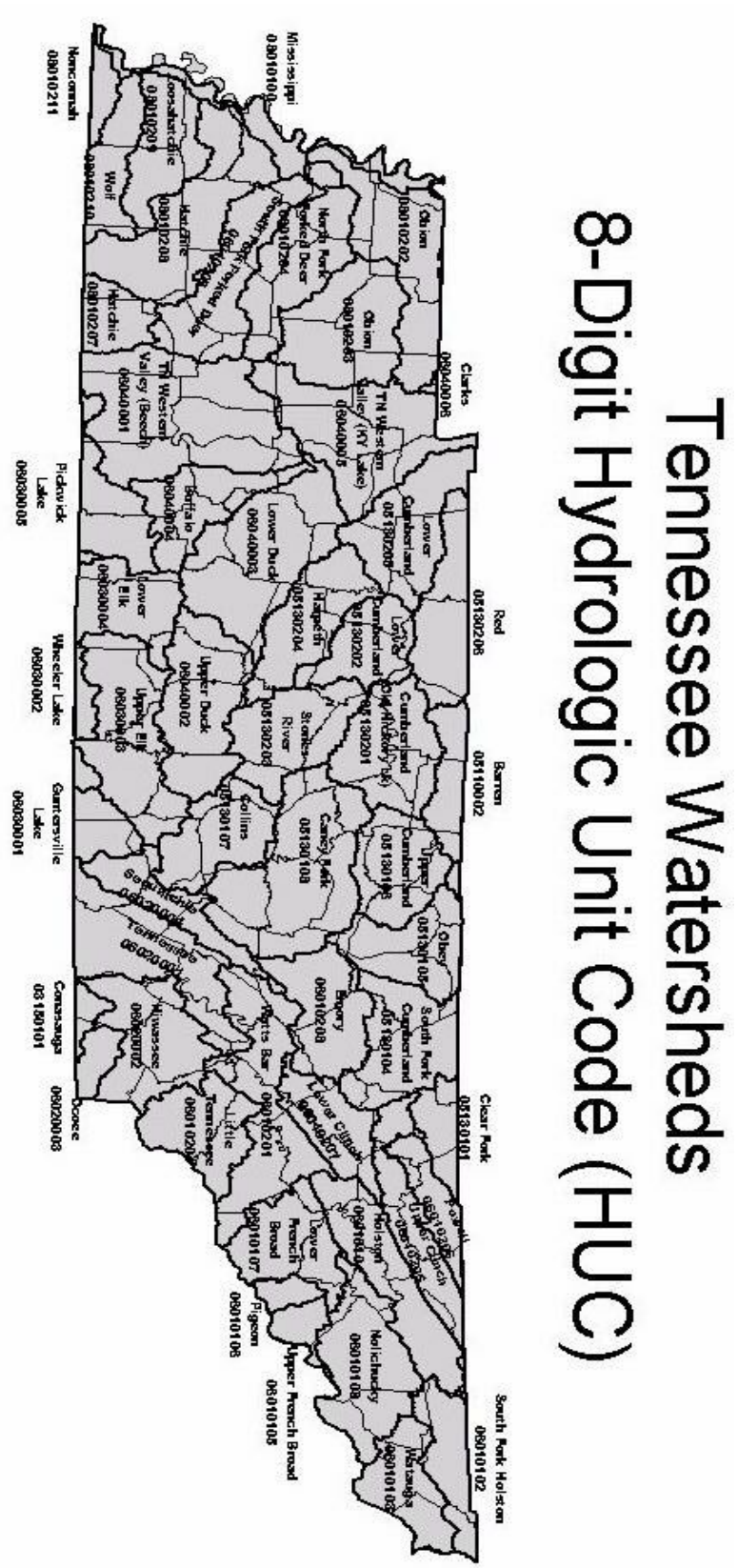
STREAM MITIGATION RATIOS

APPENDIX C

Treatments	Monitoring Requirements
Enhancement I Preservation	Level I
Enhancement II	Level II
Replacement Restoration	Level III

MONITORING REQUIREMENTS

APPENDIX D



APPENDIX E

HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #_____ RIVER MILE_____	STREAM CLASS	
LAT_____ LONG_____	RIVER BASIN	
STORET#	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE_____ TIME_____ AM PM	REASON FOR SURVEY

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new-fall and not transient)	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the from of new-fall, but not yet prepared for colonization (may rate at high end of scale)	20-40% mix of stable habitat; availability less than desirable; substrate frequently disturbed or removed	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 76% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow) (Slow is<0.3m/s deep is >0.5m)	Only 3 of the 4 regimes present (if fast-shallow is missing score lower than regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low)	Dominated by 1 velocity/depth regime (usually slow-deep)
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low –gradient streams) of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills> 75% of the available channel; or 25 % of channel substrate is exposed.	Waters fills 25-75 % of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

APPENDIX E (Continued)

HABITAT ASSESSMENT DATA SHEET- HIGH GRADIENT STREAMS (BACK)

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present	Channelization may be extensive; embankments or shoring structures, present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5-7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >35.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
8. Bank Stability (score each bank) **Note: determine left or right side by facing downstream.**	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods	Unstable; many eroded area; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars
SCORE____(LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE____(RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protective (score each bank) **Note: determine left or right side by facing downstream**	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height
SCORE____(LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE____(RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone > 18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE____(LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE____(RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

TOTAL SCORE _____

Adapted from Appendix A-1 Habitat Assessment and Physiochemical Characterization Field Data Sheets – Form, EPA 841-B-99-002

APPENDIX F

HABITAT ASSESSMENT DATA SHEET- LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #_____ RIVER MILE_____	STREAM CLASS	
LAT_____ LONG_____	RIVER BASIN	
STORET#	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE_____ TIME_____ AM PM	REASON FOR SURVEY

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient)	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the from of new-fall, but not yet prepared for colonization (may rate at high end of scale)	10-30% mix of stable habitat; availability less than desirable; substrate frequently disturbed or removed	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation present.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variabilitly	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low – gradient streams) of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills> 75% of the available channel; or 25 % of channel substrate is exposed.	Waters fills 25-75 % of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

APPENDIX F (Continued)

HABITAT ASSESSMENT DATA SHEET- LOW GRADIENT STREAMS (BACK)

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present	Channelization may be extensive; embankments or shoring structures, present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
7. Channel Sinuosity	The bends in the stream increase the stream length 3-4 times longer than if it was in a straight line. (Note – channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.	The bends in the stream increase the stream length 2-3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
8. Bank Stability (score each bank) **Note: determine left or right side by facing downstream.**	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods	Unstable; many eroded area; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars
SCORE____(LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE____(RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protective (score each bank) **Note: determine left or right side by facing downstream.**	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height
SCORE____(LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE____(RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone > 18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE____(LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE____(RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

TOTAL SCORE _____